↓ Edit

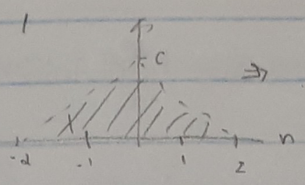
Design Problem Part I

cache Angus

1) $S_1 = -1$ V

$S_2 = +1$ V

→ pdf



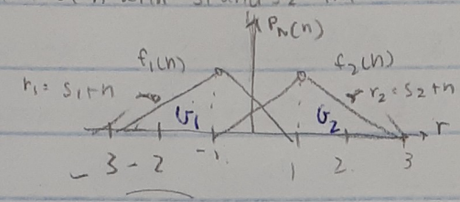
$$\Rightarrow P_N(n) = \begin{cases} C/2\,x + C & -2 < x \le 0 \\ -C/2\,x + C & \text{if } 0 < x \le 2 \\ \emptyset & \text{otherwise} \end{cases}$$

→ $C = \int_{-2}^{0} C/2\,x + C + \int_{0}^{2} -C/2\,x - C = 1 \Rightarrow \left[\frac{(C/2)x + C(x+2)}{2}\right]_{-2}^{0} + \left[\frac{2C}{2} + \frac{(-C/2x + 2C)x}{2}\right]_{0}^{2} = 1 = C$

$= \left[\frac{(C/2)(0) + C(0+2)}{2}\right] - \emptyset + \left[C + \left(\frac{-C}{2}\cdot 2 + 2C\right)2\right] - \emptyset = 1$

$= 3C - C = 1 = \boxed{C = 1/2}$

→ adjust pdf of n with S_1 and S_2 inputs → P



For $S_1 = -1$, for R receive S_1 → $P(S_1) = 0.25$

$$P_R(r_1) = \begin{cases} 1/4\,r + 3/4 & \text{if } -3 < r \le -1 \\ -1/4\,r + 1/4 & \text{if } -1 < r \le 1 \\ 0 & \text{otherwise} \end{cases}$$

Note: to choose signal 1 or 2

↳ r has to have a greater a posteriori

For $S_2 = 1$ or R recieve S_2 → $P(S_2) = 0.75$

prob → $P_1 p\{\bar{r}|S_1\} > P_2 p\{r|S_1\}$

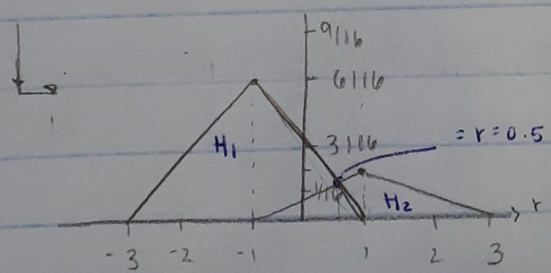
$$P_R(r_2) = \begin{cases} 1/4\,r + 1/4 & \text{if } -1 < r \le 1 \\ -1/4\,r + 3/4 & 1 < r \le 3 \\ 0 & \text{otherwise} \end{cases}$$

So we say H_1 vs H_0, where we choose H_1 as the hypothesis S_1 was sent

$\Rightarrow P_1 p\{r|S_1\} > P_2 p\{r|S_1\}$

$$H_1 \text{ (chosen)} \cdot P(r|S_1) = 0.75 P_R(r_1) = \begin{cases} 3/16\,r + 9/16 & \text{if } -3 < r \le -1 \\ -3/16\,r + 3/16 & \text{if } -1 < r \le 1 \\ 0 & \text{otherwise} \end{cases}$$

$$H_2 = P(r|S_2) = 0.25 P_R(r_2) = \begin{cases} 1/16\,r + 1/16 & \text{if } -1 < r \le 1 \\ -1/16\,r + 3/16 & \text{if } 1 < r \le 3 \\ 0 & \text{otherwise} \end{cases}$$



$= r = 0.5$ when $r < 0.5$, then H_1 should be chosen, otherwise $r > 0.5 \rightarrow H_2$

Threshold voltage for choosing signal 1 = 0.5V